

SSFP APPROACH TO SOFTWARE REUSE

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This talk began by presenting the Space Station Freedom Program (SSFP) definitions of software commonality and software reuse. Software commonality is the use of identical, interchangeable, functionally compatible, or similar software items to satisfy different sets of functionally similar requirements. The Software Support Environment (SSE) and the Data Management System (DMS) of onboard computing facilities are examples of SSFP common software. Software reuse is the use of identical, compatible, or similar software items in either modified or unmodified form to satisfy development activities at any point in the software life cycle; in other words, taking an existing item and applying it to another development activity. Software commonality has been mandated in several critical areas (such as the SSE and DMS) and a policy directive is under review. A software reuse study group was established in May 1988 to gather background information (see Level II Software Reuse Study that follows by Scott Herman). The SSFP Program Definition and Requirements Document contains requirements for SSE support in the area of software reuse. The SSE is a collection of tools and rules, and provides the common environment to be used for the life cycle management of all SSFP operational software. Operational software includes ALL flight and ground software that either (1) interfaces with on-orbit elements in real time, (2) is critical to the mission, or (3) is SSE software. The SSE supports software development in Ada and provides tools for process management, software production, integration, test and verification, as well as training and library management. The SSE will provide the mechanisms required to implement SSFP evolving strategies for software reuse.

SPACE STATION FREEDOM PROGRAM (SSFP) APPROACH TO SOFTWARE REUSE

- **Definitions**
- **Status**
- **Introduction to the Software Support Environment (SSE)**
- **Summary**

SSFP APPROACH TO SOFTWARE REUSE

DEFINITIONS

Software Commonality: Use of identical, interchangeable, functionally compatible, or similar software items to satisfy different sets of functionally similar requirements.

- Common items are from any phase of life cycle
- Items are used without modifications

Software Reuse: Use of identical, compatible, or similar software items in either modified or unmodified form to satisfy development activities at any point in the software life cycle.

- Reusable items already exist
- Reusability is determined by how well the existing item satisfies requirements or derived attributes of current development activity

Status

- Software Commonality
 - Has been mandated in several critical areas such as:
 - Software Development (SSE)
 - Onboard data management (DMS)
 - Level II Policy directive under review
- Software Reuse Strategy
 - Level II study group was established May 1988 to gather background information
 - Level II sponsored "Reusable Software Flight Certification Requirements" task
 - Level II Policy directive under review
 - The Software Support Environment (SSE) is mandated to support the SSFP reuse strategy
 - Participation in this workshop is part of the process

SSFP APPROACH TO SOFTWARE REUSE

The SSFP Level II requirements for SSE support in the area of software reuse are baselined in SSP 30000 Sec. 11, Rev. A dated October 15, 1988 as follows:

5.3.7 REUSABLE SOFTWARE

The SSE shall provide the capability for identifying and controlling the use of software components which may be used in multiple applications via a controlled library of reusable components. The SSE shall identify, maintain, and support the dissemination of reusability standards and reusable software components for SSP operational software.

INTRODUCTION TO THE SOFTWARE SUPPORT ENVIRONMENT (SSE)

- **What is the SSE?**
- **Why does Space Station need the SSE?**
- **SSE Implementation Approach**
- **Who are the SSE Users?**
- **SSE Functionality**
- **Conclusion**

WHAT IS THE SSE?

- **SSE is a collection of:**
 - **Tools (software)**
 - **Rules (procedures, standards, s/w production hardware specs, documentation, policy, training materials)**
- **SSE provides the common environment to be used for the life cycle management of all SSP operational software**
- **The SSE supports all SSP facilities involved in software life cycle management. These facilities include:**
 - **Work package and KSC Software Production Facilities**
 - **The Multi-System Integration Facility (MSIF)**
 - **The SSE Development Facility**
- **The SSE supports and provides mechanisms to enforce program-wide policies and standards such as:**
 - **Standard programming language (Ada)**
 - **Common User Interface standards**
 - **Software documentation standards**
 - **Common software verification approach**

DEFINITION OF OPERATIONAL SOFTWARE

Operational Software is:

ALL flight and ground software that either

(1) interfaces with on-orbit elements in real time

or

(2) is critical to the mission,
- **such as all control center, test, and certification software**
- **including associated models and simulations**

or

(3) SSE software

WHY DOES SPACE STATION NEED THE SSE?

- **Software is high risk for the SSP in terms of both safety and cost**
 - **Large amount of software to be developed**
 - **Integration and testing are major issues - multiple developers are organizationally and geographically distributed**
 - **Sustaining engineering is a major cost factor in the SSP software life cycle**
- **SSE provides the means to control SSP software life cycle costs**
 - **The SSE is a single implementation of tools and rules rather than many**
 - **SSE enables consolidation of contractors and skills for sustaining engineering of SSP software**
- **SSE provides the means to control SSP software quality**
 - **Common program-wide standards and tools will be utilized for software integration and testing**

SSE IMPLEMENTATION APPROACH

- **Single contractor for SSE development - Contract awarded to Lockheed Missiles & Space Co., Inc. (LMSC)**
 - Contract Start (CSD) - 7/10/87
 - Contract Duration is 6 yrs with additional 3 yr option
 - Contract Type - Completion form for 1st year
Level of effort beginning 7/10/88
 - Contractor Location - Houston, Texas
- **SSE System Project Office is located in the Reston, Va. Space Station Program Office, Information System Services Program Group**
 - Supported by Program Support Contractor (PSC) in Reston
 - Contract management support from JSC Institution, Spacecraft Software Division
- **Incremental Development**
 - SSE Interim System delivered 9/10/87
 - Used by LMSC to develop the Operational SSE
 - Available to SSP software developers for familiarization, training and early SSP development activities
 - First Operational SSE Release 11/10/89
 - Integrated Tools
 - No Proprietary Software
 - Additional Operational Releases each year

WHO ARE THE SSE USERS?

- **SSE users include all persons involved in the life cycle management of SSP software. They include:**
 - Software Project Managers
 - Requirements Analysts
 - Software Designers
 - Software Developers
 - Testers
 - Quality Managers
 - Software Configuration Managers
- **The majority of SSE users will be Work Package Contractors**
- **Other SSE users will include:**
 - NASA SSP organizations (e.g. MSIF)
 - KSC and non-prime contractors
 - Space Station users
 - International Partners
- **The SSE Users Working Group (SSEUWG) provides the forum for SSE user information exchange and input to the project**

SSE FUNCTIONALITY

- **The SSE supports software development in Ada**
 - **Ada is baselined as the language of choice for the SSP**
 - **SSE can be expanded to support additional languages if required**
- **The SSE Ruleset provides software standards, guidelines and procedures to support software acquisition, integration, verification and maintenance**
- **The SSE Toolset provides all software tools necessary to acquire, integrate and deliver SSP operational software during all life cycle phases. SSE tools encompass the following functional areas:**
 - **SSE Process Management**
 - **Software Management Support**
 - **Software Production**
 - **Flight Software Integration, Test and Verification**
 - **Data Reconfiguration**
 - **Training**
 - **Library Management**

CONCLUSIONS

- **The SSE provides a single common environment for the life-cycle management of all SSP operational software**
- **The SSE provides a mechanism for program-wide enforcement of approved standards and methodologies**
- **SSE support in the critical areas of software integration and testing will help to maintain SSP safety requirements**
- **Effective use of the SSE will minimize the cost of software ownership throughout the entire SSP life cycle**

Summary

- The SSFP understands the potential benefits of software commonality and reuse
- Some mandates are in place regarding software commonality
- The software reuse strategy is evolving
- The SSE will provide the mechanisms required to implement SSFP strategies for software reuse